

II. AMENDMENTS TO THE SPECIFICATION:

Please amend the specification as follows in accordance with 37 C.F.R. § 1.121:

At page 1, line 5 - line 12, please replace the paragraph with the following replacement paragraph.

FIELD OF THE INVENTION

The present invention relates generally to a system and methods for ~~optimising~~ optimizing the production performance of a milk producing animal herd. More specifically, it provides automated or semi-automated means for dynamic real time ~~analyses~~ analysis of milk compounds and parameters to provide quantitative analytical data that are indicative of the overall physiological and nutritional state of the milking animals and which, if required, permit appropriate corrective measures to be taken.

At page 1, line 15 - line 23, please replace the paragraph with the following replacement paragraph.

TECHNICAL BACKGROUND AND PRIOR ART

It is known to monitor the physiological and nutritional condition of milking animals, such as cows. It is also known to collect data from individual milking animals, including data for milk yield and composition, health condition data, feeding scheme data and breeding data such as genetic data. A currently common procedure is to collect milk samples manually from individual milking animals at regular intervals and subsequently ship the samples to a central laboratory for chemical and biological ~~analyses~~ analysis, thereby deriving information on the milk quality as well as the health condition of each individual milking animal.

At page 1, line 25 - line 30, please replace the paragraph with the following replacement paragraph.

In most milk producing countries, dairy herd improvement associations (DHIAs) will collect, evaluate and distribute such data relating to e.g. milk yield, milk quality and mastitis (i.e. inflammation of the mammary gland). Based on these data that are available from

the DHIA's, the dairy farmers can select the best milking animals for breeding, make appropriate adjustments to feeding schemes and control health to thereby ~~optimise~~ optimize the milk production.

At page 1, lines 32 - 38, please replace the paragraph with the following replacement paragraph.

However, this current procedure for collecting such data is cumbersome and it requires a substantial amount of manpower as the milk samples are collected manually at the milk production unit and shipped to central laboratories to be ~~analysed~~ analyzed. Consequently, milk from each milking animal is typically only ~~analysed~~ analyzed 6-12 times per year. Using such a procedure it is not possible for the individual farm manager to take immediate corrective actions and, e.g., implement feeding scheme adjustments or initiate prophylactic measures or antibiotic treatments to control disease conditions.

At page 2, lines 29 - 37, please replace the paragraph with the following replacement paragraph.

Several automated systems for monitoring selected compounds and parameters in milk have been developed. Thus, US 5,873,323 discloses a method of milking animals automatically while determining whether the milking animal is diseased or in oestrus. Sensors are placed in the milking conduit system leading from the teat cups. The sensors measure simultaneously several parameters including milk flow, milk temperature and electric conductivity of the milk (mastitis detection). The data obtained by the measurements are provided to a computer which compares the new data with similar data from immediately preceding selected periods of time to identify aberrant values that indicate which animals are diseased or in oestrus.

At page 3, lines 1 - 11, please replace the paragraph with the following replacement paragraph.

US 5,743,209 discloses a system and method for monitoring and controlling milk production at dairy farms that is capable of qualitative analysis of the composition of

milk samples using IR/NIR optical probes. Compounds that are ~~analysed~~ analyzed simultaneously include fat, protein, somatic cells (indicator for mastitis), casein, lactose and urea. EP 896 222 A3 discloses a system for monitoring and controlling protein ~~utilisation~~ utilization in animals by automatically ~~analysing~~ analyzing the urea content in milk using a sensor unit containing urease. SE 9902972 discloses a method and a system for ~~analysing~~ analyzing milk during the milking operation, including simultaneous ~~analyses~~ analysis of somatic cells, "clots", salt ions and progesterone. The ~~analysing~~ analyzing means are generally light emitter means and light detection means, however, there is, in very general terms, referred to the use of a biosensor for measuring ~~i.a.~~ i.e., progesterone, urea and ketone bodies.

At page 3, lines 13 - 21, please replace the paragraph with the following replacement paragraph.

The achievement of the highest possible productivity of a milk producing animal herd is an extremely complicated task, as the productivity is highly dependent on a variety of factors including: (i) optimal ~~utilisation~~ utilization of feed rations which requires that feeding schemes are designed on an individual animal basis or a group basis and is continuously adjusted according to the milk yield (lactation state); (ii) tight control of subclinical and clinical disease conditions that have an adverse effect on milk yield and composition; (iii) optimal reproduction control including the selection of the most appropriate point in time for insemination to avoid any reduction of overall milk yield due to deferment of new pregnancy, and reliable detection of pregnancy.

At page 3, lines 23-28, please replace the paragraph with the following replacement paragraph.

Ideally, an automated or semi-automated system for ~~optimising~~ optimizing the production performance of a milk producing animal herd should therefore have the capability to provide, on a real time basis, quantitative measurements of a combination of compounds and parameters in milk samples from individual herd members or a group of herd members that are indicative of all of (i) the health condition, (ii) the physiological condition, (iii) the nutritional and energy state, (iv) the state in the oestrus cycle and (v) pregnancy.

At page 3, lines 31 - 36, please replace the paragraph with the following replacement paragraph.

From the above, it is evident that the overall production characteristics of an individual herd member will vary considerably over time, e.g., depending on its state in the lactation cycle and the reproduction cycle which will, e.g., have a significant impact on the feed requirements and ~~utilisation~~ utilization of that particular herd member. This variation implies that the range of compounds and parameters that it is required to monitor at any given point in time varies.

At page 3, line 38 - page 4, line 10, please replace the paragraph with the following replacement paragraph.

In addition to being capable of generating data for all relevant milk compounds and parameters that are required to fully ~~optimise~~ optimize the production performance of a milk producing animal herd, the ideal automated or semi-automated system should be cost-effective. This implies that the individual analytical processes should be based on relatively cheap methods. As it is described in the following, a significant reduction in costs can be achieved by designing the production performance monitoring system such that an individual milk sample collected at a given point in time is only ~~analysed~~ analyzed for compounds or parameters that need to be ~~analysed~~ analyzed at the particular point in time to ~~optimise~~ optimize the production performance of the particular herd member or the particular group of herd members. Thus, to illustrate this point, compounds/parameters indicative of mastitis may be ~~analysed~~ analyzed on a daily basis whereas compounds/parameters that are indicative of whether or not an animal is in heat need only be ~~analysed~~ analyzed at pre-selected periods of time.

At page 4, lines 12 - 18, please replace the paragraph with the following replacement paragraph.

Additionally, it is highly advantageous that the ideal production performance monitoring system is capable of generating quantitative analytical data for selected compounds and parameters, for which even relatively small day-to-day variations are highly predictive for a change in the overall health condition, the physiological condition, nutritional and

energy state, the state in the oestrus cycle or pregnancy of the individual herd member being tested. This requires that the system is provided with analytical means that permits frequent quantitative ~~analyses~~ analysis to be made at a cost-effective level.

At page 4, lines 20 - 27, please replace the paragraph with the following replacement paragraph.

The present inventors have now developed a system for ~~optimising~~ optimizing the production performance of a milk producing animal herd, which meets all of the above requirements of an ideal system for ~~optimising~~ optimizing production performance of milk producing herds. The system is based on the findings that frequent and continuous real time measurements of one or more of a broad range of carefully selected compounds or parameters indicative of and related to the physiological and nutritional condition of individual milking animals provide the means of continuously ~~optimising~~ optimizing the overall production performance of the milking animal herd and hence the profitability of the dairy farm.

At page 5, lines 1 - 7, please replace the paragraph with the following replacement paragraph.

It is therefore a primary objective of the invention to provide the means to ~~optimise~~ optimize the productivity and profitability of a milk producing animal herd, in particular a herd of dairy cows. The objective is met by providing a novel automated or semi-automated system that is capable of real time analysis of a broad range of compounds and parameters in individual animal milk samples and to continuously process the thus obtained analytical data to provide, when required, the basis for taking immediate corrective steps to improve productivity of one or more herd members.

At page 5, lines 9 - 16, please replace the paragraph with the following replacement paragraph.

It is one significant feature of the system that the number of compounds or parameters out of those possible that is to be ~~analysed~~ analyzed by the system at any given point in time is dependent, e.g., on the reproduction or lactation cycle state of the individual

animal. This is made possible by operationally linking the analytical means to a database containing information on the reproduction and lactation state of each herd member or any other information that may be used to determine whether or not a particular milk compound or parameter should be ~~analysed~~ analyzed at a particular point in time. In this manner the system operates in a "dynamic" mode.

At page 5, line 18 - page 6, line 16, please replace the paragraph with the following replacement paragraph.

Accordingly, the invention pertains in one aspect to an automated or semi-automated system for ~~optimising~~ optimizing the production performance of a milk producing animal herd comprising a plurality of individual herd members each assigned a unique identification code that is ~~recognisable~~ recognizable by the system, the system comprising the following interconnected means:

- (a) means for collecting a milk sample from an individual member of said herd, said means is connectable to the herd milking system,
- (b) means for ~~recognising~~ recognizing the identification code of the individual herd member,
- (c) means for storing data including data for the physiological and nutritional state of said each individual herd member including data indicating point in time in the reproduction and lactation cycles,
- (d) means for ~~analysing~~ analyzing a plurality of compounds or parameters in a milk sample being collected, said means comprising:
 - (i) separate means for ~~analysing~~ analyzing individual compounds or parameters in the milk sample, each of said separate means is capable of generating a detectable signal in the presence of an individual milk compound or parameter,
 - (ii) means for directing a part of the milk sample to each separate ~~analysing~~ analyzing means, said directing means being controlled by said means for storing data for the physiological and nutritional state of each individual herd

member such that the directing means is only activated at pre-selected points in time or at pre-selected time intervals in the reproduction or lactation cycles,

(iii) means for detecting signals generated in the presence of a compound or parameter being ~~analysed~~ analyzed,

(e) means for converting the detected signals to a set of data that is indicative of the physiological and/or nutritional condition of said individual herd member,

(f) means for storage of said set of data ~~descriptive~~ indicative of the physiological and/or nutritional condition for said individual herd members, and

~~(e)~~ (g) data output means.

At page 6, lines 18 - 37, please replace the paragraph with the following replacement paragraph.

In a further aspect there is provided a method for ~~optimising~~ optimizing the production performance of a milk producing animal herd using the system as defined above. The method comprises the steps of:

(i) collecting at a milking site a milk sample from each individual member of the herd,

(ii) contacting said sample with the ~~analysing~~ analyzing means that, in the presence of at least one compound or parameter indicative of the physiological and/or nutritional condition of the herd member, generates a detectable signal/detectable signals,

(iii) recording in the signal detection means the character of said signal(s) to provide a set of analytical data indicative of the presence and/or amount of said compound or parameter,

(iv) having the generated data processed to provide a set of data descriptive of the physiological and/or nutritional condition of the individual herd member, and

(v) taking, on the basis of the set of data provided, appropriate steps to improve or correct the physiological and/or nutritional condition of any of the herd members in need of such improvement or correction.

At page 7, line 1 - page 8, line 17, please replace the paragraph with the following replacement paragraph:

In yet a further aspect the invention relates to a method for ~~optimising~~ optimizing the production performance of a milk producing animal herd comprising a plurality of individual herd members using an automated or semi-automated system for ~~optimising~~ optimizing the production performance of a milk producing animal herd, the system comprising the following interconnected means:

- (a) means for collecting a milk sample from an individual member of said herd, said means is connectable to the herd milking system,
- (b) means for ~~recognising~~ recognizing a unique identification code assigned to each of the individual herd member,
- (c) means for storing data including data for the physiological and nutritional state of said each individual herd member including data indicating point in time in the reproduction and lactation cycles,
- (d) means for ~~analysing~~ analyzing a plurality of compounds or parameters in a milk sample being collected, said plurality of compounds or parameters at least including a compound or parameter indicative of mastitis, a compound indicative of the reproduction cycle state, at least one compound indicative of the protein balance of the herd member and at least one compound indicative of the energy balance state of the herd member, said ~~analysing~~ analyzing means comprising
 - (i) separate means for ~~analysing~~ analyzing individual compounds or parameters in the milk sample, each of said separate means is capable of generating a detectable signal in the presence of an individual milk compound or parameter, and
 - (ii) means for detecting signals generated in the presence of a compound or parameter being ~~analysed~~ analyzed,

(e) means for converting the detected signals to a set of data that is indicative of the physiological and/or nutritional condition of said individual herd member,

(f) means for storage of said set of data descriptive of the physiological and/or nutritional condition for said individual herd members, and

~~(e)~~ (g) data output means,

the method comprising the steps of:

(i) collecting at a milking site a milk sample from each individual member of the herd,

(ii) contacting said sample with the ~~analysing~~ analyzing means that, in the presence of at least one compound or parameter indicative of the physiological and/or nutritional condition of the herd member, generates a detectable signal/detectable signals,

(iii) recording in the signal detection means the character of said signal(s) to provide a set of analytical data indicative of the presence and/or amount of said compound or parameter,

(iv) having the generated data processed to provide a set of data descriptive of the physiological and/or nutritional condition of the individual herd member, and

(v) taking, on the basis of the set of data provided, appropriate steps to improve or correct the physiological and/or nutritional condition of any of the herd members in need of such improvement or correction.

At page 8, lines 19 - 33, please replace the paragraph with the following replacement paragraph.

In a further aspect the invention provides an apparatus for ~~analysing~~ analyzing a plurality of compounds or parameters in a milk sample of an individual member of a milk producing animal herd, said apparatus comprising:

(i) separate means for ~~analysing~~ analyzing individual compounds or parameters in the milk sample, each of said separate means is capable of generating a

detectable signal in the presence of an individual sample compound or parameter,

(ii) means for directing a part of the milk sample to each separate ~~analysing~~ analyzing means, said directing means being controlled by means for storing data for the physiological and nutritional state of each individual herd member, including data indicating point in time in the reproduction and lactation cycles of said herd member, such that the directing means is only activated at pre-selected points in time or at pre-selected time intervals in the production or lactation cycles of the individual herd member.

At page 8, line 36 - page 9, line 9, please replace the paragraph with the following replacement paragraph.

DETAILED DISCLOSURE OF THE INVENTION

The primary objective of the invention is to provide an automated or semi-automated system for ~~optimising~~ optimizing the production performance of a milk producing animal herd.

As used herein, the term "automated" implies that the system can be operated substantially without manual operations. Thus, the term indicates that milk samples are automatically collected on-line at the milking site from the milking system and automatically transported to analytical means which in turn automatically generate analytical data that are processed automatically to update the system and to provide instructions to the farm management for corrective measures. The milking site may be a milking site of an automatic milking system for freely moving milking animal or one of several milking sites in a conventional milking system such as a herringbone milking system. The milking site may also be at rotating or parallel milking ~~parlours~~ parlors.

At page 9, lines 15 - 21, please replace the paragraph with the following replacement paragraph.

The term "production performance" as used herein, is intended to mean the production performance in its broadest aspect. Thus, included in this term is milk production,

including milk quantity and quality, reproductive performance of herd members, e.g., the number of offspring per milking animal and optimum ~~utilisation~~ utilization of feed rations. Although the system is particularly useful in dairy cow herds, the term "milk producing animal herd" is intended to mean any herd comprising milk producing animals including, e.g., sheep, goats, camels and buffaloes.

At page 9, lines 23 - 26, please replace the paragraph with the following replacement paragraph.

It is an advantageous feature of the present system that it is capable of ~~recognising~~ recognizing unique identification codes carried by the herd members, such as, e.g., bar codes, e.g., involving an alpha-numeric code, or other electronic signal types generated by electronic devices such as radio transmitters, assigned to each individual member of the herd.

At page 9, lines 27 - 39, please replace the paragraph with the following replacement paragraph.

The system of the invention comprises several operationally interconnected elements which may or may not be physically connected. As one such element, the system of the invention comprises means for collecting at a milking site milk samples from individual members of a milking animal herd. Typically, the sample collecting means is the physical connection between the milking points and the ~~analysing~~ analyzing means. The function of the sample collecting means is to collect milk samples to be ~~analysed~~ analyzed at the appropriate time during the milking process and to subsequently transport and present the samples to the ~~analysing~~ analyzing means. However, in both automated and semi-automated systems, it is conceivable that the sample collecting means is not in direct physical connection with the ~~analysing~~ analyzing means, but the system may be designed so as to deliver a sample being collected to a separate means for storing milk samples, which in turn can be operationally connected to the ~~analysing~~ analyzing means as it will be explained in the following.

At page 10, lines 17 - 25, please replace the paragraph with the following replacement paragraph.

Suitable means for that purpose include a container, which is connected to the general milking system line, optionally by pressure control means permitting that the pressure in the container can be different from that of the milking system. With such a design the pressure in the container is the same as that of the milking system when the milk sample is being collected, but when a subsample of the total sample should be generated for analysis, the container is subjected to a pressure that exceeds the pressure of the milking system. The sample storage means can be positioned at any location which permits the subsequent and/or parallel transport of subsamples to the ~~analysing~~ analyzing means to occur such as, e.g., at the milking site.

At page 10, lines 27 - 32, please replace the paragraph with the following replacement paragraph.

When a milk sample is stored in the storage means, a certain separation of milk components such as fat may occur. As it is critical that subsamples that are to be contacted with the ~~analysing~~ analyzing means ~~has~~ have the natural composition it may be appropriate to provide the means for storing a milk sample with means for continuously mixing, ~~homogenising~~ homogenizing or agitating the milk sample during storage. One example of such means is a magnetic stirring device.

At page 10, line 34 - page 11, line 11, please replace the paragraph with the following replacement paragraph.

It is generally required to design the sample storage means such that it can be flushed or cleaned in between samples. Suitable flushing or cleaning media include milk, air, water, detergent solutions or combinations thereof. During storage of a sample, it may be appropriate to add a buffer solution or a dilute solution to the sample. Additionally, it may be advantageous to provide the sample storage means with temperature control means. Accordingly, in useful embodiments, the sample collecting means further comprises or is operationally connected with at least one of (i) means permitting the sample collecting means to be cleaned between samples, (ii) means for storing a buffer

solution or a dilute solution, (iii) means for connecting the means for storing a milk sample to the analytical means, the means for storing a buffer solution or a dilute solution, the milking system and/or a sample discharge outlet, (iv) means for controlling the temperature of the milk sample being collected and (v) means for transporting the milk sample being collected. Additionally, the means for collecting a milk sample may comprise means for apportioning a milk subsample to the ~~analysing~~ analyzing means. The general function of such means is to divide the total sample collected during the milking operation into one or more subsamples which is/are transported to the ~~analysing~~ analyzing means and the remaining part of the sample which may be led to the milk bulk tank or discharged.

At page 11, line 33 - page 12, line 2, please replace the paragraph with the following replacement paragraph.

A major objective of the invention is, as it is mentioned above, to provide a system that provides the means to ~~optimise~~ optimize the production performance of a milk producing animal herd. A key element in the system is to provide for real time "dynamic" analysis of a range of compounds and parameters to generate analytical data that, when assessed separately or in combination and, optionally compared with previous data for the compounds or parameters, enable the herd manager to take appropriate corrective actions. The compounds and parameters to be ~~analysed~~ analyzed are selected so as to provide for each herd member a comprehensive description of the health condition, physiological condition, energy and nutritional condition and state in reproduction cycle.

At page 12, lines 4 - 9, please replace the paragraph with the following replacement paragraph.

Accordingly, the system comprises in a preferred embodiment separate means for ~~analysing~~ analyzing individual compounds or parameters in the milk sample that include means for ~~analysing~~ analyzing at least one compound or parameter selected from the group consisting of a compound or parameter that is indicative of mastitis, a compound or parameter that is indicative of the reproduction cycle state of the milking animal and a

compound or parameter that is indicative of the energy and nutritional state of the milking animal.

At page 12, lines 11 - 21, please replace the paragraph with the following replacement paragraph.

In the present context the term "mastitis" is to be understood as an inflammatory reaction of the mammary gland. Mastitis is the most loss-making production disease in the dairy industry. Thus, annual losses from mastitis in the USA ~~amounts~~ amount to more than 2 billion dollars. Decreased milk production, discarded milk, reduced raw milk quality, medical costs and higher culling rates are the most important economic consequences of both subclinical and clinical mastitis. However, public health, product quality and shelf life, animal care, and consumer perception provide additional economic incentives to control mastitis. Mastitis is positively correlated to milk yield and despite much effort little improvement in reduction of incidence of mastitis, if any, has occurred during the last couple of decades. Thus, it is of major importance for the dairy farmer to have an early, or more preferably, an instant indication of mastitis, including subclinical mastitis, in order to ~~minimise~~ minimize the production losses.

At page 12, lines 24 - 31, please replace the paragraph with the following replacement paragraph.

Mastitis is often ~~characterised~~ characterized by the cause of the disease which may be infectious, traumatic or toxic. When mastitis occurs, the intramammary tissue is damaged, followed by an increased permeability between the blood and milk compartments, resulting in changes in milk composition. Subclinical mastitis can only be detected by laboratory tests whereas clinical mastitis can be detected by clinical examination of the milk and/or the udder. The pathogens most often found in connection with mastitis are bacteria such as e.g. *Escherichia coli*, *Staphylococcus aureus*, *Micrococcus* spp., *Streptococcus uberis*, *Streptococcus agalactiae* and *Streptococcus dysgalactiae*.

At page 13, lines 4 - 8, please replace the paragraph with the following replacement paragraph.

Accordingly, in one useful embodiment the system of the invention comprises separate ~~analysing~~ analyzing means for ~~analysing~~ analyzing a compound or parameter indicative of mastitis that is selected from the group consisting of somatic cells, microbial cells or parts thereof, an enzyme, a protein, a fat, a lipid, a mineral, a trace element, milk temperature, conductivity of the milk, a particle that is separable by filtration and any combination thereof.

At page 13, lines 12 - 20, please replace the paragraph with the following replacement paragraph.

An example of a specific compound the amount of which is indicative of mastitis is beta-N-acetylhexosaminidase (NAGase), an intracellular, lysosomal enzyme (E.C. 3.2.1.52), belonging to a group of glycosidases. NAGase is involved in glycoprotein catabolism and is present in plasma. The concentration of NAGase in plasma is typically 11 to 20 times of that found in normal milk and two to four times that of mastitic milk. The function of NAGase in mammary secretions is presently not known. In one embodiment, the system of the invention comprises separate ~~analysing~~ analyzing means for ~~analysing~~ analyzing NAGase that is capable of detecting an amount of NAGase which is in the range of 0 to 0.1 U/ml including 0.01 to 0.09 such as 0.02 to 0.08, e.g., 0.03 to 0.05 U/ml.

At page 13, lines 22 - 28, please replace the paragraph with the following replacement paragraph.

In the present context, a further enzyme of interest as an indicator of mastitis is lactate dehydrogenase (LDH) that is also normally present in plasma at substantially higher levels than in milk and the amount of which is therefore increased in milk from inflamed mammary glands. In a further embodiment, the present system comprises separate ~~analysing~~ analyzing means for ~~analysing~~ analyzing LDH that is capable of detecting an amount of LDH in milk which is in the range 100 to 2000 U/ml such as the range of 200 to 1500 U/ml, e.g., the range of 500 to 1000 U/ml.

At page 13, lines 30 - 37, please replace the paragraph with the following replacement paragraph.

In order to ~~optimise~~ optimize the overall production performance of a milk producing animal herd, it is pertinent to closely monitor the state in reproduction cycle of each individual animal in order to select the optimum time for insemination, i.e. to determine the optimum reception time in the cycle. However, it is difficult to visually observe and closely monitor, on an individual herd member basis, a large herd. It is particularly difficult to identify the first heat event after calving and lactation start in cows at the time interval between 40 and 65 days post calving. Therefore, automatic methods permitting reliable and frequent monitoring of the state in reproduction cycle are needed.

At page 14, lines 8 - 16, please replace the paragraph with the following replacement paragraph.

Accordingly, in one preferred embodiment the system of the invention comprises separate ~~analysing~~ analyzing means for ~~analysing~~ analyzing a compound or parameter such as a hormone, the presence or amount of which in milk is indicative of the reproduction cycle state of the milking animal that is selected from the group consisting of a compound that indicates pro-oestrus, a compound that is indicative of oestrus (heat), a compound that indicates di-oestrus and a compound that indicates pregnancy. In this context, one presently preferred hormone is progesterone. In useful embodiments, the separate ~~analysing~~ analyzing means for ~~analysing~~ analyzing progesterone is capable of detecting an amount hereof in the milk sample which is in the range of 0 to 30 ng/ml, including 0 to 20 ng/ml, such as 1 to 15 ng/ml or 2 to 10 ng/ml.

At page 14, lines 18 - 30, please replace the paragraph with the following replacement paragraph.

The feeding of milking animals is a factor of the utmost importance in ~~optimising~~ optimizing the production performance of the animals. A general problem in current dairy farming is that the individual milking animals are not continuously fed optimally. Thus, high yielding milking animals are as a matter of convenience frequently offered

the same feed ration as low yielding milking animals. It is also a problem that the milk yield of the same individual herd member varies according to its state in the lactation cycle for which reason the nutrient requirements of the herd member ~~is~~ are constantly changing. One important aspect in relation to the composition of the feed for milking animals is that the crude protein content of the feed should be continuously ~~optimised~~ optimized in order to improve the overall crude protein balance of the milking animal. In the present context the term "protein balance" is used to designate the ratio between the amount of protein which is taken up by the milking animal and used for milk and tissue production, and the amount of urea excreted from the milking animal.

At page 14, line 32 - page 15, line 2, please replace the paragraph with the following replacement paragraph:

It is known to use the content of urea in milk as an indication of the protein balance of a milking animal, i.e. as an indicator of the milking animal's ~~utilisation~~ utilization of feed ration nitrogen. The urea concentration in the blood of milking animals varies and is affected, e.g., by protein intake and urinary excretion. If the milking animal consumes feed with a content of crude protein that is too high for complete microbial conversion in the gastrointestinal tract, e.g., in the rumen of the milking animal, this will result in higher blood urea levels. As blood urea is freely ~~diffusable~~ diffusible into milk, changes in blood urea levels will cause a corresponding change in milk urea level normally denoted milk urea nitrogen (MUN).

At page 15, lines 4 - 10, please replace the paragraph with the following replacement paragraph:

Accordingly, milk urea nitrogen (MUN) can be used in accordance with the invention as an indicator, e.g., for ~~optimising~~ optimizing a feeding scheme and/or for pointing out possibilities for changing the composition of the feed. Thus, regular MUN measurements can be applied to precisely and instantaneously adjusting the nitrogen requirements of each individual milking animal. Additionally, MUN measurements can aid the dairy farmer in, e.g., reducing feed costs, to increase the overall milk protein yield, and to ~~minimise~~ minimize nitrogen excretion into the environment.

At page 15, lines 12 - 21, please replace the paragraph with the following replacement paragraph.

In one useful embodiment the system of the invention therefore comprises separate ~~analysing~~ analyzing means for ~~analysing~~ analyzing a compound or parameter indicative of the energy and/or nutritional state of the milking animal which is a compound or parameter that is indicative of the protein balance of the milking animal including milk urea nitrogen (MUN) and total milk protein. It has been found that a combination of MUN and total milk protein values are particularly useful as an indication of protein balance. In useful embodiments, the system comprises separate ~~analysing~~ analyzing means for ~~analysing~~ analyzing a compound or parameter that is indicative of the protein balance of the milking animal which is capable of detecting an amount of MUN which is in the range of 0 to 1000 mg/l including 0 to 700 mg/l such as 10 to 500 mg/ml or 100 to 400 mg/ml.

At page 15, lines 23 - 34, please replace the paragraph with the following replacement paragraph.

As it is discussed above, the metabolic performance of the milking animal is particularly relevant for the overall production performance of each individual milking animal, and hence the entire herd. Ketosis is a metabolic disorder affecting the metabolic performance which is frequently encountered in dairy animals such as cows, in particular during certain periods of the lactation cycle. The primary cause of ketosis is a lack of available energy for the mammary gland in early lactation resulting in an aberrant energy balance of the animal. When milking animals are affected by this metabolic disorder, they typically lose weight and produce less milk. Immediate feed ration adjustment is needed to prevent and treat the disorder. The disorder is ~~characterised~~ characterized by elevated levels of ketone bodies in the tissues and body fluids, including blood, milk and urine. In the present context "ketone bodies" includes compounds such as acetolactate, beta-hydroxybutyrate (BOHB) and acetone.

At page 15, line 36 - page 16, line 5, please replace the paragraph with the following replacement paragraph.

Accordingly, in one useful embodiment the system of the present invention comprises separate ~~analysing~~ analyzing means for ~~analysing~~ analyzing a compound or parameter that is indicative of the overall energy balance of the milking animal including a ketone body compound and the total milk fat content. In specific embodiments, the ketone body compound is selected from the group consisting of acetolactate, beta-hydroxybutyrate (BOHB) and acetone. In presently preferred embodiments, such ~~analysing~~ analyzing means is capable of detecting an amount of BOHB in milk which is in the range of 0 to 0.7 mM including an amount hereof which is the range of 0.1 to 0.5 mM such as, e.g., in the range of 0.2 to 0.4 mM.

At page 16, lines 7 - 19, please replace the paragraph with the following replacement paragraph.

As it discussed above, it is one useful characteristic of the system of the invention that a range of compounds and parameters that, for each individual herd member provides a comprehensive picture of all of (i) the health condition, (ii) the physiological condition, (iii) the nutritional and energy state, (iv) the state in the oestrus cycle and (v) pregnancy can be analysed. Accordingly, in preferred embodiments the system of the invention comprises separate means for ~~analysing~~ analyzing at least one compound or parameter selected from the group consisting of NAGase, lactate dehydrogenase (LDH), progesterone, milk urea nitrogen, total protein content, BOHB, total fat content and milk yield. In certain embodiments, the system comprises ~~analysing~~ analyzing means for at least the following compounds/parameters: (i) an enzyme that is indicative of mastitis such as NAGase or LDH, a hormone compound indicative of state in the reproductive cycle such as progesterone, a compound indicative of protein balance such as MUN and/or total protein content and a compound indicative of the energy state such as acetone, a ketone body or BOHB.

At page 16, lines 21 - 27, please replace the paragraph with the following replacement paragraph.

In addition to these compounds and parameters, the system may comprise or may be linked to means for ~~analysing~~ analyzing any other compound or parameter that may be present or occur in milk samples such as, e.g., somatic cells, ~~filtratable~~ filtrable clots/particles, pathogenic and saprophytic microorganisms including coliform bacteria, psychrotrophic bacteria or parts thereof such as fat, proteins, lipopolysaccharides, conductivity, added water, carbohydrates, immunoglobulins, enzymes such as, e.g., lactoperoxidase, lactoferrin, whey proteins, caseins, amino acids, fatty acids and residues of drugs including antibiotics.

At page 16, line 29 - page 17, line 9, please replace the paragraph with the following replacement paragraph.

As also discussed above, it is one advantageous feature of the invention that the parameters/compounds can be ~~analysed~~ analyzed in a dynamic mode, i.e. that only those compounds or parameters which, at a given point in time of the reproduction and/or lactation cycle of the individual herd members should be ~~analysed~~ analyzed in a particular milk sample. This is achieved by providing in the system means for storing data including data for the physiological and nutritional state of said each individual herd member including data indicating point in time in the reproduction and lactation cycles and by connecting such means operationally with means for ~~analysing~~ analyzing a plurality of compounds or parameters in a milk sample being collected, comprising: (i) separate means for ~~analysing~~ analyzing individual compounds or parameters in the milk sample, each of said separate means is capable of generating a detectable signal in the presence of an individual milk compound or parameter, (ii) means for directing a part or a subsample of the milk sample to each separate ~~analysing~~ analyzing means, said directing means being controlled by the above means for storing data for the physiological and nutritional state of each individual herd member such that the directing means is only activated at pre-selected points in time or at pre-selected time intervals in the production or lactation cycles. In this connection, one interesting feature is that the means for storing data for the physiological and nutritional state of each

individual herd member is continuously updated with new data, so that the selection of the range of compounds/parameters that are ~~analysed~~ analyzed in a given sample at a given point in time is based on a constantly updated set of data for the particular herd member.

At page 17, lines 11 - 20, please replace the paragraph with the following replacement paragraph.

As illustrative examples, it may be appropriate to ~~analyse~~ analyze about 20 samples for heat/pregnancy annually, e.g., 5 times per week in periods of expected oestrus and samples about 3 weeks post-oestrus and about 20 samples for detection of anoestrus. ~~Analyses~~ Analysis for compounds/parameters that are indicative of mastitis may be carried out at each milking or once every day. With respect to ~~analyses~~ analysis for protein balance indicators, a suitable frequency may be once a week and may only be carried out for a proportion of the herd members, e.g., at least 10%, 20% or 30% of the herd members throughout the lactation period. Compounds that are indicators for the energy state of the animals such as BOHB, acetone or total fat content may, e.g., be ~~analysed~~ analyzed once daily in the first two months of post-calving.

At page 17, lines 22 - 33, please replace the paragraph with the following replacement paragraph.

The ~~analysing~~ analyzing means of the system may be selected from any analytical means known in the art for ~~analysing~~ analyzing any of the above compounds/parameters. Illustrative examples of such ~~analysing~~ analyzing means ~~includes~~ include enzyme based assays, immunologically based assays, biosensors, biochemical assays, spectrometric assays, wet chemistry assays, sequential injection analysis and flow injection analysis assays which are suitable for ~~analysing~~ analyzing the presence of the compounds or parameters. Preferably, the ~~analysing~~ analyzing means are designed to perform quantitative measurements. In one useful embodiment the ~~analysing~~ analyzing means comprises solid support analytical means or devices which, e.g., may be in the form of test strips (also known as dry sticks) comprising appropriate reagent(s) that in the presence of the compound being ~~analysed~~ analyzed generate(s) a detectable signal. Additionally, the ~~analysing~~ analyzing means may

comprise or may be operationally linked to means for storing and transporting such solid support analytical devices.

At page 17, lines 35 - 39, please replace the paragraph with the following replacement paragraph.

Additionally, the system of the present invention comprises means for detecting signals generated by the analytical means in the presence of a compound or parameter being analysed analyzed. Such signals may e.g. be in the form of intensity, frequency, ~~colour~~ color, number etc. Any conventional means for detecting such analytical signals are encompassed by the present invention.

At page 18, lines 1 - 12, please replace the paragraph with the following replacement paragraph.

It is contemplated that the means for ~~analysing~~ analyzing a plurality of compounds or parameters in a milk sample may be analytically linked, i.e., physically connected to a single means for collecting a milk sample as described above, but it is also conceivable that the ~~analysing~~ analyzing means is analytically linked to a plurality of such milk sample collecting means, which, e.g., may be located at the milking site(s), i.e., the ~~analysing~~ analyzing means and the milk collecting means may be spatially separated. When the ~~analysing~~ analyzing means is linked to a plurality of sample collecting means, the thus collected milk samples are suitably transported to the ~~analysing~~ analyzing means via a tube element, via a conveyer element or by hand. In any of these ways of transportation, the individual milk samples may be collected and transported in appropriate enclosure elements such as, e.g., bags of flexible polymeric material, containers of plastic, glass or metal or any other suitable sample container,

At page 18, lines 14 - 15, please replace the paragraph with the following replacement paragraph.

In a further useful embodiment, the system according to the invention has means for ~~analysing~~ analyzing a plurality of compounds or parameters placed at each milking site.

At page 19, lines 5 - 15, please replace the paragraph with the following replacement paragraph.

For the purpose of data analysis, the system according to the invention may comprise an internal database and/or an external database having multiple data relating to previous ~~analyses~~ analysis of milk samples for the presence of compounds or parameters which are indicative of the physiological and/or nutritional condition of milk producing animal herd members. It will be appreciated, that in order to support these databases, software such as database management systems (DBMS) is required to handle the storage and retrieval of data, and in order to provide the user with commands to query and update the database. Examples of such database management systems include hierarchical and relational database management systems. The database management systems is preferably stored on a memory device and is executable for query on a computer system. Access to the management systems is conveniently via the internet.

At page 19, lines 26 - 38, please replace the paragraph with the following replacement paragraph.

Thus, it is contemplated that when a plurality of data obtained from individual herds are transmitted to and stored in the external database, this external or central database will, after a period of time, contain a substantial amount of ~~organised~~ organized data for many milking animals from many areas. Statistical processing of this large number of data is expected to allow for ~~continue~~ continuous improvements of early diagnosis of abnormal physiological and/or nutritional condition of milking animals such as cows. A significant advantage hereof is that such external and central databases will contain data from a large number of animals from a particular district or region, e.g., a whole country or even the whole world. The large number of data will provide a basis for extensive statistical processing of the data in order to reveal new information. As a special advantage any indications of the occurrence of epidemic illnesses among, e.g., cows is expected to be easier to reveal and ~~recognise~~ recognize. It is contemplated that the communication to and from the external or central database may be via the internet.

At page 20, lines 25 - 34, please replace the paragraph with the following replacement paragraph.

In accordance with the above description, useful embodiments of the system of the invention ~~comprises~~ comprise data storage means which comprises a database containing for each individual herd member multiple data related to previous ~~analyses~~ analysis of milk samples from herd members for the presence of individual compounds or parameters including data for identifying the milking site, milk yield data, data to identify the individual herd members, data related to parity, reproduction state and lactation state of the herd members including data indicating points in time in the reproduction and lactation cycles, data for time of sample collections, historical analytical data for the physiological and nutritional state, historical data for compositions of milk samples, feeding scheme data, disease ~~rec22ord~~ record data including data for previous disease treatments.

At page 21, lines 13 - 25, please replace the paragraph with the following replacement paragraph.

In a further aspect, the invention pertains to a method for ~~optimising~~ optimizing the production performance of a milk producing animal herd using the system as described above, the method comprising the steps of: (i) collecting at a milking site a milk sample from each individual member of the herd, (ii) contacting said sample with the ~~analysing~~ analyzing means of the present system that, in the presence of at least one compound or parameter indicative of the physiological and/or nutritional condition of the herd member, generates a detectable signal/detectable signals, (iii) recording in the signal detection means the character of said signal(s) to provide a set of analytical data indicative of the presence and/or amount of said compound or parameter, (iv) having the generated data processed to provide a set of data descriptive of the physiological and/or nutritional condition of the individual herd member, and (v) taking, on the basis of the set of data provided, appropriate steps to improve or correct the physiological and/or nutritional condition of any of the herd members in need of such improvement or correction.

At page 21, line 27 - page 22, line 9, please replace the paragraph with the following replacement paragraph.

As mentioned above, the invention provides in a still further aspect a method for ~~optimising~~ optimizing the production performance of a milk producing animal herd comprising a plurality of individual herd members using an automated or semi-automated system for ~~optimising~~ optimizing the production performance of a milk producing animal herd, the system comprising the following interconnected means: (a) means for collecting a milk sample from an individual member of said herd, said means is connectable to the herd milking system, (b) means for ~~recognising~~ recognizing a unique identification code assigned to each of the individual herd member, (c) means for storing data including data for the physiological and nutritional state of said each individual herd member including data indicating point in time in the reproduction and lactation cycles, (d) means for ~~analysing~~ analyzing a plurality of compounds or parameters in a milk sample being collected, said plurality of compounds or parameters at least including a compound or parameter indicative of mastitis, a compound indicative of the reproduction cycle state, at least one compound indicative of the protein balance of the herd member and at least one compound indicative of the energy balance state of the herd member, said ~~analysing~~ analyzing means comprising (i) separate means for ~~analysing~~ analyzing individual compounds or parameters in the milk sample, each of said separate means is capable of generating a detectable signal in the presence of an individual milk compound or parameter, and (ii) means for detecting signals generated in the presence of a compound or parameter being ~~analysed~~ analyzed, (e) means for converting the detected signals to a set of data that is indicative of the physiological and/or nutritional condition of said individual herd member, (f) means for storage of said set of data descriptive of the physiological and/or nutritional condition for said individual herd members, and (g) data output means.

At page 22, lines 11 - 22, please replace the paragraph with the following replacement paragraph.

This method comprises the steps of: (i) collecting at a milking site a milk sample from each individual member of the herd, (ii) contacting said sample with the ~~analysing~~

analyzing means that, in the presence of at least one compound or parameter indicative of the physiological and/or nutritional condition of the herd member, generates a detectable signal/detectable signals, (iii) recording in the signal detection means the character of said signal(s) to provide a set of analytical data indicative of the presence and/or amount of said compound or parameter, (iv) having the generated data processed to provide a set of data descriptive of the physiological and/or nutritional condition of the individual herd member, and (v) taking, on the basis of the set of data provided, appropriate steps to improve or correct the physiological and/or nutritional condition of any of the herd members in need of such improvement or correction. In this method, all parameters, features and procedures are otherwise as described above for the system of the invention.

At page 22, lines 24 - 26, please replace the paragraph with the following replacement paragraph.

As also described above, the present invention relates in another aspect to an apparatus for ~~analysing~~ analyzing a plurality of compounds or parameters in a milk sample of an individual member of a milk producing animal herd.

At page 22, lines 28 - 38, please replace the paragraph with the following replacement paragraph.

The apparatus of the invention is useful in the system and the methods of the invention and it comprises: (i) separate means for ~~analysing~~ analyzing individual compounds or parameters in the milk sample, each of said separate means is capable of generating a detectable signal in the presence of an individual sample compound or parameter, (ii) means for directing a part of the milk sample to each separate ~~analysing~~ analyzing means, said directing means being controlled by means for storing data for the physiological and nutritional state of each individual herd member, including data indicating point in time in the reproduction and lactation cycles of said herd member, such that the directing means is only activated at pre-selected points in time or at pre-selected time intervals in the production or lactation cycles of the individual herd member, all of which features are as described above for the system and the methods of the invention.

At page 23, lines 1 - 12, please replace the paragraph with the following replacement paragraph.

In useful embodiments the apparatus further comprises means for detecting signals generated in the presence of a compound or parameter being ~~analysed~~ analyzed and such an apparatus provided with means for connecting it with at least one of: (a) means for collecting a milk sample from an individual member of said herd, said means is connectable to the herd milking system, (b) means for ~~recognising~~ recognizing an identification code of the individual herd member, (c) means for storing data including data for the physiological and nutritional state of said each individual herd member including data indicating point in time in the reproduction and lactation cycles, (d) means for converting the detected signals to a set of data that is indicative of the physiological and/or nutritional condition of said individual herd member, (e) means for storage of said set of data descriptive of the physiological and/or nutritional condition for said individual herd members, and (f) data output means, which are all as described hereinbefore.

At page 23, lines 14 - 28, please replace the paragraph with the following replacement paragraph.

The invention will be further illustrated by means of the following non-limiting examples and the drawings wherein:

Fig. 1 shows an example of the system arranged at a milking site,

Fig. 2 shows an embodiment of a data handling system for collecting, storing and processing data,

Fig. 3 shows a plurality of farmers coupled to a central system,

Fig. 4 shows one exemplary embodiment of ~~analysing~~ analyzing means according to the invention, and

Fig. 5 shows a second exemplary embodiment of ~~analysing~~ analyzing means according to the invention.

At page 23, line 33 - page 24, line 2, please replace the paragraph with the following replacement paragraph.

Analysing Analyzing equipment means arranged at a milking site

As an example, Fig. 1 shows the ~~analysing~~ analyzing equipment for ~~analysing~~ analyzing compounds indicative of the physiological condition of the milking animals arranged at a milking site in connection with sample collecting means. As can be seen from the figure, the sample collecting means is the physical connection between the milking points and the ~~analysing~~ analyzing equipment. The function of the sample collecting means is to collect milk samples to be ~~analysed~~ analyzed at an appropriate time during the milking process.

At page 24, lines 4 - 11, please replace the paragraph with the following replacement paragraph.

The milking site may be part of an automatic milking system for freely moving cows, carrying identification means, such as earmarks, or strips which may be electronically detected. In a further embodiment the milking site is one of several milking sites in a herringbone milking system. In the broadest aspect of this invention other kinds of milking sites may be applied, e.g., rotating or parallel ~~parlours~~ parlors. As can also be seen from Fig. 1, the ~~analysing~~ analyzing means may be combined with existing milking control system performing supplementary measurements such as milk volume, milk flow and temperature measurements.

At page 24, lines 24 - 35, please replace the paragraph with the following replacement paragraph.

Data handling system for collecting, storing and processing data

Figure 2 illustrates one embodiment of the present invention. As can be seen from the example in Fig. 2, the system consists of a data system comprising a local arrangement at the farm including milk sample collecting means, ~~analysing~~ analyzing means, data collection and processing, data storage, and further processing and transmission. As can be seen from Fig. 2, the processed data may be transmitted via a communication

channel, such as the internet, to external databases. In the present example the transmitted data are received and stored in an external database at a knowledge centre, such as, e.g., DHIA (National Dairy Herd Improvement Association), a scientific centre or a university. The knowledge centre is accessible to a plurality of advisors, consultants, veterinarians, scientists etc. As can be seen from Fig. 2 the knowledge database is accessible to advisors, consultants etc. through the internet. As is further illustrated on Fig. 3, the data in the external database at the knowledge centre may be collected from a number of farms.

At page 25, lines 3 - 7, please replace the paragraph with the following replacement paragraph.

Chemical analysis equipment

As mentioned above, various appropriate chemical analysis equipment or analysing analyzing means may be applied in order to perform the chemical analysis of the compounds indicative of the physiological condition of the milk producing animal.

At page 25, lines 9 - 19, please replace the paragraph with the following replacement paragraph.

Fig. 4 illustrates one example of such suitable chemical analysis equipment adapted to carry out the invention. Test strips or dry sticks 1 adapted to indicate the presence or amount of one or more of the desired compounds are stored in separate cartridges 2 holding the test strips. A test strip 3 is released from the cartridge to a conveyor belt 4. The conveyor belt advances the test strip towards a peristaltic pump 5. The inlet of peristaltic pump 6 is connected with the milk pipe line receiving milk from the milking equipment. As indicated in Fig. 4, the peristaltic pump 5 withdraws a small sample from the milk pipe line or the milk sample storage means, thereby transferring of few drops to the test strip 7. A chemical reaction takes place and the test strip is analysed analyzed by a detector or test reader 8, such as a CCD camera or other photometry equipment, having a signal output port connected to a data collecting and processing device.

At page 25, lines 21 - 38, please replace the paragraph with the following replacement paragraph.

Fig. 5 illustrates another embodiment of ~~analysing~~ analyzing means adapted to carry out the invention. Again, test strips or dry sticks 1 adapted to indicate the presence or amount of one or more of the desired compounds are arranged on a carrier tape 2 covered by a sealing tape 3. The tape is arranged on a spool 4. The sealing tape 3 is removed by rewinding on a second spool 5 shortly before the stick is exposed to the milk sample. A fast loop 6 extracts a fraction of the milk from the milk line. A valve 7 opens for a short time interval to release a few drops of milk onto a test strip 1. A funnel 8 located beneath the tape is arranged to receive the excess milk as waste. The tape is moved forward whereby the test strips 1 after having received a few drops of milk are exposed to the detector 9 and subsequently reminded on the spool 10. The detector can be a CCD camera or other photometry equipment having a signal output port connected to a data collecting and processing device. In a presently preferred embodiment the test strips or sticks on the tape are arranged to comprise at least 4 sensing areas: Acetone or BOHB (beta-hydroxyl-butyrate), progesterone, Nagase (beta-N-acetylhexosaminidase) or lactate dehydrogenase (LDH) and urea (milk urea nitrogen). It is however also contemplated to apply a tape having only one or two different sensing areas, such as sensing areas for the two most often applied compounds for indicating the physiological condition of the milk producing animal. Such compounds are, e.g., compounds indicating mastitis and milk urea nitrogen.